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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 528

OFFICE OF THE SECRETARY

Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ April 13, 1917

SEASONAL DISTRIBUTION OF FARM LABOR IN CHESTER COUNTY, PA.

By

GEORGE A. BILLINGS, Agriculturist

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The purpose of this bulletin is (1) to set forth the actual labor distribution that prevails on farms profitably conducted in a particularly successful farming community, and (2) to show how these data may be applied profitably in replanning a farm of the type covered in the survey upon which this study is based.

It often happens that when a farmer undertakes to put into operation a new system he encounters grave and unforeseen difficulties through the conflict of the labor and equipment demands of his different enterprises. Even more frequently it happens that long existing farming systems chronically suffer in their operations through the strenuous labor demands of certain seasons and through the enforced idleness of others. When an abundance of day labor, both man and horse, is easily and continually available, the problem is never a serious one. There is, however, a great advantage in being able to employ labor by the season or by the year, and it is practically necessary to keep on the farm horses and equipment adequate to

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meet the maximum demands of the rush season. It is important, therefore, that the farmer contemplating a change in his cropping system should have some method by which he may measure the labor requirements of a proposed system to determine its feasibility under his limitations as to labor and equipment. It is equally important for the farmer who is already encountering difficulties through conflicting labor demands to be able to make an analysis of his system with a view to making changes that will obviate these difficulties. It is to give these farmers a basis upon which to plan with reference to seasonal distribution of labor that this bulletin has been prepared.

TERRITORY SURVEYED AND METHOD USED.

The region studied was the southern part of Chester County, Pa. It extends from the Maryland line on the south to the Chester valley on the north, and from the more broken region in the western part of the county to the vicinity of West Chester on the east. It includes the region already covered by a farm-management survey[1] made by this department, and, in addition, areas outside of this area having similar agricultural conditions.

This special study was conducted in the summer of 1915. Only the more successful farms were visited, that is, those yielding labor incomes above the average found in the previous farm management survey. In that study the average of 389 farm owners was $789. The 215 farmers visited were selected from this list except a few from closely adjoining territory. The object of this survey was to study the farm practice and labor efficiency of well-managed farms, to the exclusion of others.

By "labor income" is meant the amount of money that the farmer has left after paying all business expenses of the farm and deducting 5 per cent for interest on the money invested in the farm business.

By "farm practice" in this connection is meant the general order of performing the various farm operations, from the application of manure, plowing, and preparation of seed bed to the marketing of the crop. Data as to the different types of implements and other equipment used, information concerning the use of commercial fertilizers, the methods of cultivation employed, and the yield and disposition of the products were obtained in the study of farm practice.

By "labor efficiency" is meant the number of loads or tons handled or the area covered by an implement with a definite crew of men and horses, in a day or other unit of time, for every operation in the growing of the crop. In this connection estimates were obtained from the farmer as to the number of days actually available for field work throughout the growing season, the number of days actually worked

[1] "Farm Management Practice in Chester County Pa.," U. S. Dept. Bulletin No. 341.

in hauling manure or marketing a crop in winter, and the average number of hours worked per day for each month. From the data on the distribution and efficiency of labor, factors have been worked out by which it is possible to calculate very closely the amount of horse and man labor required for any cropping system and for any arrangement and acreage of crops, provided of course that topography, climate, and other conditions approximate those that obtain where this study was made.

The second part of the bulletin illustrates the application of these data and the factors derived therefrom in the operation of a typical Chester County farm, offering a concrete example that may be used to more or less advantage by the farmer who wishes to replan his farming system along the lines here suggested.

LABOR EFFICIENCY AS AFFECTED BY SOIL, TOPOGRAPHY, AND FIELD ARRANGEMENT.

The average efficiency for any crew working tillage machinery will vary to some extent with the kind of soil, the size and shape of the field, the rough or rolling nature of the field, and the amount and distribution of rainfall. These things must be considered, therefore, when the following data are to be used in regions where the conditions vary to any considerable extent from those that prevail in Chester County.

The surface soil of the Chester loam,[1] which is mapped on the greater part of this area, is a mellow, soft, brown silty loam about 10 inches in average depth, sometimes varying from a silty to a heavy loam, or to a sandy or micaceous loam. Under average climatic conditions these soils work comparatively easily when 1,200 to 1,400 pound horses are used. The soil does not easily crust or bake. Under very dry conditions it is sometimes rather difficult to plow, and some allowance should be made if clover, timothy, or alfalfa seedings are to be made in August.

The general shape of the field has much to do with the efficiency of horse labor. Where the topography is rolling and but little broken by rough wooded areas or streams the general arrangement of the fields may be changed to economize labor. In Chester County, however, we have conditions very hard to change, since the area studied is often much broken by small streams with adjacent steep slopes, often wooded, dividing the farming area into natural divisions with irregularly shaped fields which require an unusual amount of horse labor in handling farm machinery.

It is for this reason, probably, that the average number of crop acres per horse on the farms visited is less than on the farms surveyed in certain other regions. On many farms visited, however, a rear-

[1] Soil Survey of Chester County, Pa.

rangement of fields would no doubt be a strong factor in enhancing labor efficiency. Long rectangular fields require a minimum of turning, and therefore entail the least waste of time in handling implements, and there is little doubt that the averages in the labor requirements given in the following tables could be reduced if due attention were given to this detail.

The climatic conditions in this region are comparatively uniform. The average amount of rainfall for 33 years at Kennett Square is 49 inches, and the average monthly rainfall for the six summer months during this period is 4.6 inches. Under good soil management, such as has been followed on the farms visited, the soils are generally retentive of moisture, intertilled grain crops suffer but little, and the season is exceptional that forces the farmer to break the regular routine of plowing or preparation for seeding.

TYPES OF FARMING.

Few agricultural regions have a more uniform type of farming than that found in southern and central Chester County. The character of the soil is especially adapted to the growing of forage crops and grain, especially corn, wheat, clover, and timothy. These favorable conditions and the fact that this region is convenient to good markets—Philadelphia, Pa., and Wilmington, Del.—is probably the reason why general farming and dairying is the principal type of farming in this region. The systems of farming followed have not materially changed in the last 50 years.

The fruit industry until recently has been confined to the home orchard, which, as a rule, has received but little care and has given but little return. However, on selected slopes where the drainage is good, apples are now commanding increased attention. A number of new orchards have been planted, and the returns from those orchards which have begun to bear indicate a future for the fruit industry.

Hitherto soy beans have not been grown in Chester County to any great extent, but it is believed that this is a crop which may profitably take the place of oats in the rotation. The acreage in oats has decreased in recent years. Evidently the farmers are finding this crop unprofitable. Soy beans have been successfully grown by a few Chester County farmers, and their great advantage from a farm management standpoint, in that the product has a high feeding value, can be harvested for hay or grain, and that the crop has considerable influence in soil improvement, makes this legume a promising crop for this region.

Three years ago less than 1 per cent of the farmers visited grew alfalfa, but the acreage has been rapidly increasing since then. How-

ever, if alfalfa becomes a prominent hay crop, this may have a marked effect on the cropping systems.

The production of corn, wheat, and hay combined with live stock—generally dairy cattle—brings the most uniformly profitable returns to the Chester County farmer. Beef cattle are found only on a few of the larger farms.

The rotation generally practiced by all farmers, as well as as those visited, is as follows:

1. Corn planted on timothy sod, usually harvested for grain, but sometimes for silage.
2. Corn for silage, potatoes, oats, or soy beans.
3. Wheat.
4. Clover and timothy for hay.
5. Timothy for hay, one or two years.

There is practically no change in the order of succession of these crops, and all variations usually come the second year after breaking the sod.

VARIATIONS IN METHOD.

Manure is generally applied for corn, potatoes, alfalfa, and often as a top dressing on mowing land and pasture. It is seldom applied for wheat or oats. About 50 to 60 per cent of the 165 farmers from whom labor records were obtained haul out manure only in the spring and fall, 5 to 10 per cent do so daily, and the remainder weekly. There is little difficulty, however, in finding a place to spread manure profitably at any season of the year.

The greater number of these farmers plow in the spring, though considerable areas of sod are often fall plowed. Except on steep slopes, which are apt to wash badly, fall plowing of sod is of advantage because it will facilitate spring work.

There is more or less variation even among the best farmers in the preparation for seeding. It is their universal practice, however, to roll or plank-drag a field immediately after plowing, to compact the soil, level, and give a surface better fitted for the action of the harrow which follows. The majority of these farmers use a disk harrow, working it one or more times for each crop, which is usually followed by a spike-tooth smoothing or a spring-tooth harrow, finishing the preparation with a roller or plank-drag. Until recently the spring-tooth harrow was generally used on these farms, but this is being replaced by the disk harrow. A large number of these successful farmers, however, entirely prepare for seeding with a spring-tooth harrow and a plank-drag. The spike-tooth harrow is not in as general use here as in some other regions, and is used largely in surface finishing preparatory to seeding and for harrowing corn or potatoes just preceding cultivation. The weeder is little used, its place being taken by the spike-tooth harrow.

There is a growing opinion among farmers in the part of Chester County where these records were taken that midsummer plowing should not be done, but the preparation for wheat, for alfalfa, and for timothy and clover seeded in August should be with disk and surface harrows only. This opinion is backed up by demonstrations from a number of farmers. They reason (1) that it is very hard to compact the soil after plowing at this season of the year so as to obtain good moisture conditions for seeding; and (2) that by plowing the farmer turns under roots, stubble, and other humus material and brings up soil containing less humus, which makes the field more apt to wash badly during the winter and early spring season. If disk harrowing is done at the proper time there is very little difficulty in working under stubble or manure and obtaining a firm, fine seed bed. There is little difference, however, between the two systems in the amount of labor required.

When fertilizer is applied for corn it is distributed broadcast more often than in the planter; on the other hand, fertilizer for potatoes is seldom broadcasted, but applied in the row at the time of planting.

The practice of applying lime once during the rotation is increasing. Years ago farmers used burned lime freely, and many farms in the county still show abandoned lime kilns. Then the practice of using commercial fertilizers gradually replaced the general custom of applying lime until the soils got into such a condition that the practice of liming the soil had to be resumed. The application of caustic lime in the form of burned stone lime, slaked, and applied by hand is gradually being superseded by the use of ground stone lime, prepared hydrated lime, or finely ground limestone. This is undoubtedly due to the fact that burned or stone lime must be slaked before applying while the pulverized forms of lime or limestone can be handled more conveniently by a distributor. In fact, it was impossible to obtain sufficient labor data for handling lime by hand, as the lime spreader is generally used. Lime is usually applied at the time of preparation for wheat, for clover and timothy, or for alfalfa in order to obtain a good stand of these legumes.

While these farmers grow from 1 to 5 acres of potatoes, or an average of about 4 acres, this crop, as a rule, has not given profitable yields; the average yield on the farms visited was only 84 bushels per acre. The cause of this low yield is not easily determined, and it might well be made the subject of investigation and experimental work. Very little spraying is done for blight; what spraying is done is usually to apply poison for the potato beetle. The potato planter is generally used among the larger growers, but digging is more often done by the potato plow type of implement than by the elevator type of machine.

The ordinary method of seeding to clover and grasses in the region studied is to drill in timothy at the time of seeding wheat and broadcast clover in the spring before the ground has settled. The dry and hot weather in summer has a tendency to burn out the young clover in wheat. Hence, the practice of preparing wheat stubble and seeding both clover and timothy in August obviates this difficulty and this method of seeding is being more generally practiced.

The results obtained seem to justify the additional labor required for preparation and seeding. The writer has observed many excellent crops of clover obtained by this method of seeding, whereas by the old method it is quite common to see an overabundance of white top and other weeds. Where seeding clover in wheat is still done, clipping the wheat stubble in July or August has resulted in a better and cleaner growth the following year.

The practice of mixing alfalfa with clover and timothy for August seeding is strongly recommended by a few farmers in order not only to assist in inoculating the soil with the alfalfa bacteria, but also to improve the quality of hay. The following seed mixture has given good results: 5 to 6 quarts of alfalfa, 4 quarts o red clover, 3 quarts of alsike clover, and 2 to 3 quarts of timothy. This will usually give two cuttings annually, and sometimes three cuttings. The first will be largely of timothy and clover and the later cuttings almost pure alfalfa.[1]

Under good weather conditions, clover and timothy hay requires very little handwork except in loading and storing, and a hay loader is used on many farms. The advantage of its use, however, is doubtful with clover and alfalfa. Hay caps for protecting alfalfa are used only on a few of the farms visited, but those who do use them believe that they are of decided advantage, with very little additional labor in harvesting, and that the increased value of the hay, due to improvement in quality, is sufficient to justify their use. This improvement in quality is due to the saving of the leaves of the plant and the preservation of its original green color. The soy bean, in labor requirements, does not seriously compete with other field crops. While the preparation of oats usually interferes with the planting of corn or potatoes, ground for soy beans, on the other hand, may be prepared and planted after corn has been planted, and the crop can be harvested for hay before silo-filling time, or as grain after the corn crop has been cut. In either case, the land can be cleared in time to sow to fall grain.

[1] In order to be sure of a permanent stand of alfalfa, farmers should give attention to the essentials as to the quality of seed, use of lime, inoculation, and the preparation of the seed bed for alfalfa adopted by successful growers as the result of years of experience in the region and other regions having similar agricultural conditions.

AVAILABLE TIME FOR FIELD OPERATIONS.

In order to determine whether it is possible to carry out a proposed cropping system with a certain amount of man or horse labor, it is necessary to know the approximate number of days available for field work and the average length of the workday. This is given in Table I on a monthly basis.

TABLE 1.—*Available days for field work and hours in workday.*

Data.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Days available	3	3	10	16	19	21	22	22	21	17	14	6
Hours in workday	7	7	8	9	9	9	10	9	9	9	8	8

These figures were the averages of 195 farmers' estimates. The farmer was asked to give the average number of days actually available for field work each month, after deducting Sundays, rainy days, and days when the condition of the soil would prevent field operations. Plowing is sometimes done in December and March, but the figures in those months include also the time spent in hauling manure. An average of three days each for January and February also represents time spent in the same work.

TABLE II.—*Number of days (exclusive of rainy days and Sundays) available for the several field operations.*

Operation.	Corn.	Oats.	Potatoes.	Wheat.	Timothy and clover.	Alfalfa.
	Days.	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*
Preparation and seeding	30	15	16	32	[2] 59	25
Cultivation	21		29			
Harvesting	31	[1] 15	15	[1] 10	16	8

[1] This does not include thrashing which is hired done.
[2] Includes seeding clover and timothy in August, or timothy alone with wheat. In the latter case clover is seeded Apr. 1 to 18 following.

Table II gives the average number of days that labor can be performed in the field after deducting Sundays, rainy days, and days when the soil is unfit to cultivate, and the period of seeding, cultivating and harvesting of six of the principal crops in this region.

The application of these data will be made when it is necessary to determine whether it is possible to prepare the field, plant, cultivate, or harvest certain acreages of crops with a given field force. The preparation for corn, oats, and potatoes to a certain extent overlaps, and the farmer not infrequently plans for a greater acreage than can be planted within the limits of successful crop production. Moreover, in the case of a late spring, it is important to figure on the extra labor necessary to carry out the cropping plan or else reduce the acreage of these crops within the limits of the regular farm labor.

PERIOD OF PERFORMING FIELD OPERATIONS.

There is a considerable variation in the length of season for doing various farm operations, according to the 165 labor records, yet the average of these data obtained and charted is not far from the actual period in which most of the farmers perform these operations; at least it is sufficiently accurate to use as a guide in planning the cropping system. Figure 1 gives the period of performance of the various farm operations for corn, potatoes, oats, wheat, clover and timothy, and alfalfa.

SUCCESSION OF OPERATIONS.

Before any plan can be worked out showing the labor requirements and the general distribution of labor, the succession of farm operations with any crop must be known. The aim has been to standardize the field operations and arrange them in the order in which they are usually performed. There is considerable variation even among the more successful farmers in the manner of preparing the ground and handling the crop. The outline which follows gives the order which the greatest number of these farmers follow, with the important variations.

CORN.

(1) *Manuring.*—On sod, August to December; on stubble, early spring; 12 tons to acre. (2) *Plowing.*—Generally in spring; 12 or 14 inches, walking plow. (3) *Rolling or planking.*—Immediately after plowing. (4) *Harrowing.*—Majority use 4-horse double disk, working once each way, following with spring-tooth or spike-tooth harrow. Forty-five per cent of these farmers use spring-tooth harrow only, harrowing two to four times in different directions. (5) *Drilling fertilizer.*—With grain drill. (6) *Rolling or planking.* (7) *Planting.*—With two-row planter. (8) *Weeding.*—Spike-tooth harrow used before regular cultivation begins. (9) *Cultivating.*—Usually four times with 2-horse and once with 1-horse. (10) *Cutting and shocking.*—By hand, 36 hills to shock, binder used occasionally for silage corn. (11) *Husking and hauling.* (12) *Hauling stalks.*

POTATOES.

(1) *Manuring.*—Late fall, winter, or early spring. (2) *Plowing.*—In spring; 12 to 14 inches, walking plow. (3) *Rolling or planking.*—Following plowing. (4) *Harrowing.*—Disk used by 57 per cent of 33 farmers, from whom records were obtained, followed by spike-tooth or spring-tooth harrow; remainder use spring-tooth harrow only, working two or three times. (5) *Planting.*—Few of these farmers plant by hand. (6) *Weeding.*—With spike-tooth harrow, working twice. (7) *Cultivation.*—Four or five times with riding cultivator. (8) *Spraying.*—One to three times for potato beetles; few spray for blight. (9) *Digging, picking, and hauling.*—Many use potato plow type of digger; potatoes usually stored in cellar.

OATS.

(1) *Plowing.*—Usually in spring, sometimes the fall before (oat ground is always plowed). (2) *Rolling.*—After plowing; sometimes before seeding. (3) *Harrowing.*—Spring-tooth harrow generally used by these farmers, working the field twice. (4) *Seeding.*—With 6 to 10 foot drill. (5) *Cutting, shocking, and hauling.* (6) *Thrashing.*

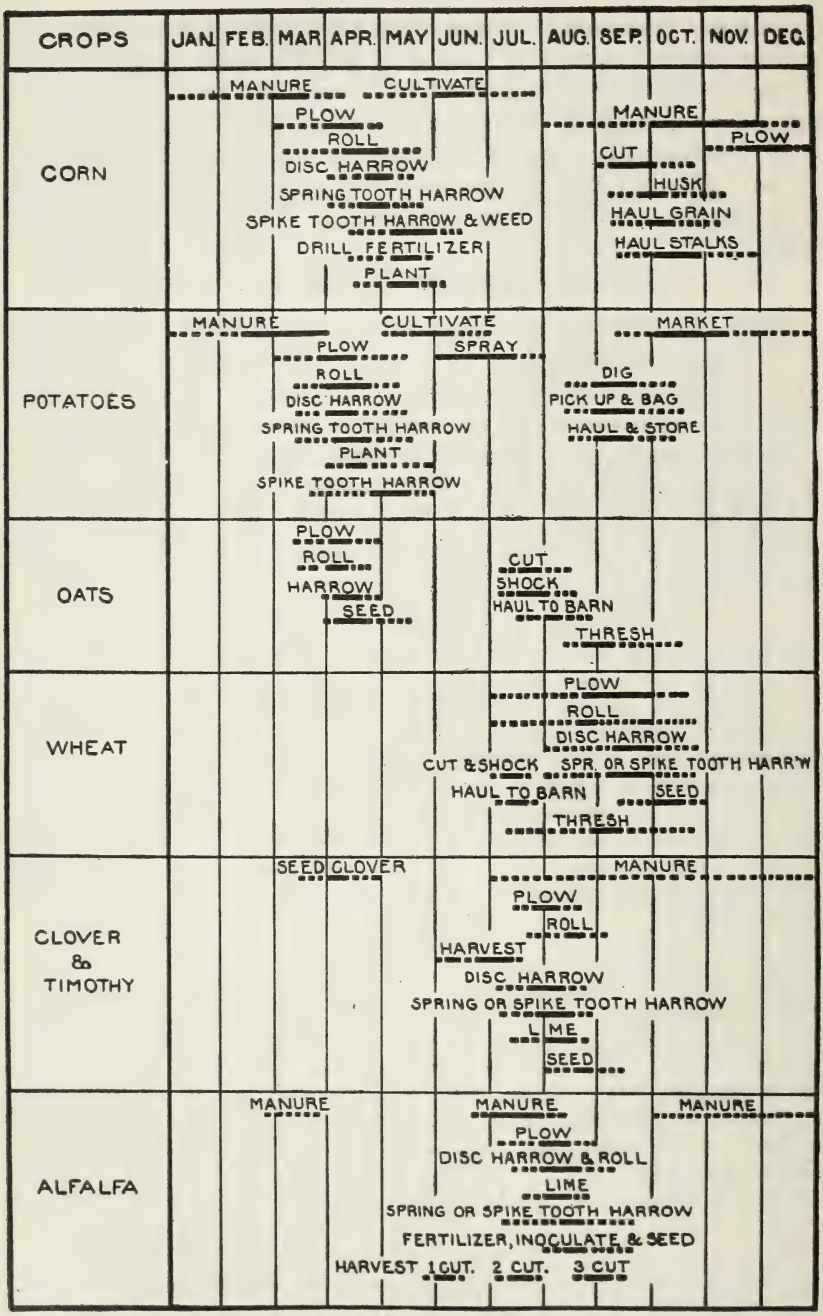


FIG. 1.—Periods of performance of farm operations (Chester County, Pa.). The full line represents the period when most of the farmers perform these operations, and the dotted line gives the range within which these operations may be performed.

WHEAT.

(1) *Plowing.*—Oat stubble, soon after harvesting, land allowed to lie fallow until about October 1; when wheat follows potatoes or corn the ground is plowed (sometimes only disked) immediately after the harvesting of those crops. (2) *Rolling or planking.*—After plowing, sometimes also before seeding. (3) *Harrowing.*—Majority of the farmers visited use disk followed by spring-tooth or spike-tooth harrow; many use spring-tooth harrow only, working two or three times; when disk is used instead of plow, the ground is worked four to six times. (4) *Seeding.*—With drill. (5) *Harvesting.*—With 3-horse 6-foot binder. (6) *Hauling*—To stack or mow. (7) *Thrashing.*—Done at barn, occasionally in the field.

TIMOTHY AND CLOVER.

(1) *Manuring.*—As top dressing on sod, in fall or winter; on new seeding, in summer. (2) *Plowing.*—Often soon after wheat harvest. (3) *Rolling or planking.*—After plowing; sometimes again before seeding. (4) *Harrowing.*—Nearly 50 per cent of the farmers visited use disk, followed by spike-tooth harrow; many use spring-tooth harrow only; a few use disk followed by spring-tooth harrow. (5) *Liming.*—Usually after wheat harvest when the land is prepared and seeded in August. (6) *Seeding.*—Timothy is seeded with wheat, and clover the following April; about 23 per cent prepare wheat stubble and seed in August. (7) *Harvesting.*—With 5-foot mower; hay fork is used and hay loader frequently.

ALFALFA.

(1) *Manuring.*—About 12 tons per acre as a top dressing or at seeding of previous crop. (2) *Plowing.*—Disk gaining in favor. (3) *Rolling or planking.*—Immediately after plowing; again between harrowings and often after seeding. (4) *Harrowing.*—Disk is generally used by these farmers, working twice after plowing; double disk three to six times when plow is not used; spring-tooth harrow sometimes follows disking, but more often follows plowing without disking. (5) *Liming.*—With the distributor, except in a few instances. (6) *Inoculation.* (7) *Seeding.*—With drill or wheelbarrow seeder, 20 to 25 pounds per acre. (8) *Cutting.* (9) *Tedding.*—Tedder not always used when followed by side-delivery rake. (10) *Raking.*—Side-delivery rake generally used; some of the smaller farms use a dump rake. (11) *Cocking.*—Immediately after raking when the hay is to be protected with hay caps; in this case hay stands in cock for one to three days and is opened up two hours before hauling. (12) *Hauling.*—Where a loader is used the hay is picked up from the windrow. (13) *Top dressing.*—Manure sometimes applied in fall; fertilizer in early spring or immediately after first or second cutting. (14) *Harrowing.*—Disk or special sharp-pointed spring-tooth harrow often used after cutting, to eradicate blue grass and weeds.

CREWS AND MACHINERY.[1]

In order to determine the amount of labor in man-days and horse-days necessary to perform any operation, it is necessary to know the crew, that is, the number of men and horses, the number of acres covered in a 10-hour day, or the number of tons or loads handled in the same period of time, and the average length of the work day. If these data are in tons or loads, by knowing the capacity of the wagon, the rate of application, and the yield of crop, the acreage covered can be obtained. From these data the day's work per acre for man or horse can be determined.

[1] See U. S. Department Bulletin No. 3, A Normal Day's Work for Various Farm Operations.

TABLE III.—*Crews and duty of machinery in plowing and preparation of soil (average of 165 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
				10-hour day.		9-hour day.	
	Men.	Horses.		Man.	Horse.	Man.	Horse.
Manuring,[1] 12 loads, 14.4 tons	1	2	1.44	0.7	1.40	0.77	1.54
Manuring,[1] 14 loads, 16.8 tons	2	2	1.68	1.19	1.19	1.50	1.50
Manuring,[2] 14 loads, 16.8 tons	3	2	1.68	1.79	1.19	2.25	1.50
Plowing, 14-inch walking plow	1	2	1.80	.55	1.10	.62	1.24
Plowing, 2-gang plow, 24 inch	1	4	3.60	.28	1.11	.28	1.11
Rolling,[3] 9-foot to 12-foot width	1	2	15.00	.07	.14	.07	.14
Disk harrowing (single)	1	2	9.10	.11	.22	.12	.24
Disk lapping half (single)	1	2	4.50	.22	.44	.25	.50
Disk harrowing (double)	1	4	9.50	.11	.44	.12	.48
Spring-tooth harrowing	1	2	10.00	.10	.20	.11	.22
Spike-tooth harrowing	1	2	12.00	.08	.16	.09	.18
Spike-tooth harrowing	1	3	13.50	.07	.22	.08	.24
Distributing lime[4] (machine)	1	2	10.50	.09	.18	.11	.22
Hauling lime to spreader	1	2	12 loads.	.09	.18	.11	.22
Drilling fertilizer	1	2	8.00	.12	.24	.14	.28

[1] With manure spreader, 10 tons per acre.
[2] Spread by hand.
[3] A plank drag is often used instead of a roller with the same duty per acre.
[4] On the basis of 1½ tons per acre.

Table III gives crews and duty of machinery as the average on 165 farms for plowing and preparation of seed bed for the principal crops of the region. By duty of machinery is meant the amount of work accomplished in a day. For example, one man with a 14-inch plow and two horses will plow on an average 1.8 acres of land. Dividing 1, or the number of men, by 1.8, the result will be 0.55, which means that it takes 0.55 of a 10-hour day, or 5.5 hours, for one man with a team to plow an acre. In the same way, dividing 2, or the number of horses, by 1.8, or the acreage plowed in one day, the result is 1.1, which means that it requires 1.1 days, or 11 horse-hours, to plow an acre. This is expressed in horse-days, or a fraction of a horse-day, rather than team-days, in order to have the figures on a uniform basis, as a crew may be made up of two or more horses. In the same manner, the day's labor per acre is given for the average length of day devoted to field work in that region, which is 9 hours per day, except in July during harvest, when full time is made.

In hauling manure with a crew of one man and two horses, or two men and two horses, a manure spreader was used. The second man in this case helped load and did not make full time, but the day was so broken that very little other work could be accomplished. In the case of a crew of three men with two horses, two wagons were used, one man loading and two men spreading by hand.

The figures for plowing include both sod and stubble, hence for sod the acreage plowed will be a little less and for stubble land slightly greater than the average. Very inconclusive data were obtained on the working of the 2-gang plow, as only a few are in

use. It is quite possible also that the acreage plowed in July and August, when the ground is dry and compact, will be less than the figures given.

The average disk harrow has usually 12 disks in the single and 24 disks in the double acting harrow, from 14 to 16 inches in diameter, with a cutting surface about 8 feet wide. The spike-tooth harrow is usually 2 to 3 section, with a cutting surface of from 8 to 12 feet, and the spring tooth has a cutting surface of from 6 to 8 feet in width. The plank drag is usually made with three planks overlapping, and the man usually rides. Following a deep-working harrow the drag is an excellent tool for leveling and breaking clods.

TABLE IV.—*Crews and duty of machinery in cultivating and harvesting corn (average of 24 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
				10-hour day.		9-hour day.	
	Men.	Horses.		Men.	Horses.	Men.	Horses.
Planting (2-row machine)	1	2	10.50	0.11	0.21	0.11	0.22
Weeding	1	1	18.00	.06	.06	.06	.06
Spike-tooth harrow	1	2	13.00	.08	.16	.08	.16
Cultivating[1]	1	2	7.70	.13	.26	.15	.30
Cutting:							
50-bushel yield	1	0	1.25	.80	.....	.88	.....
60–80-bushel yield	1	0	1.00	1.00	.....	1.11	.....
80 bushels and over	1	0	.85	1.18	.....	1.32	.....
Husking:							
50-bushel yield	1	0	.74	1.35	.....	1.50	.....
60–80-bushel yield	1	0	.53	1.80	.....	2.09	.....
80 bushels and over	1	0	.44	2.27	.....	2.53	.....
Hauling grain	1	2	2.20	.45	.90	.50	1.00
Do	2	2	3.20	.62	.62	.70	.70
Hauling stalks	2	2	5.00	.40	.40	.44	.44
Do	3	2	6.50	.45	.30	.51	.34
Filling silo:[2]							
Cutting by hand and loading	6	0					
Hauling to cutter	4	8					
Feeding the cutter	1	0	4.00	3.50	2.00	.....	.....
Storing in silo	2	0					
Running engine	1	0					

[1] This operation is usually performed 4 times.

[2] Average yield of silage corn, 12 tons per acre.

Table IV gives crews and duty of machinery as the average on 24 farms for planting, cultivating, and harvesting corn. Planting is usually done with a 2-row planter. The figures used do not include the drilling of fertilizer in the row at the time of planting, which consumes extra time, and allowance should be made in the acreage planted where fertilizer is applied. The figures for spike harrowing in this table are for harrowing after planting.

Field corn is usually checked 3½ feet each way by most of these farmers, though a number of good corn growers are planting in drills. Silage corn is planted either in drills or in hills. No figures were obtained for hand planting, as the 2-row planter is universally used. Corn is cut and shocked by hand except where it is to be put in the

silo. "Horses" or "gallows" for supporting each shock, which are made by tying the tops of four hills, are often made a number of days before cutting, if there is any danger of the corn blowing over.

The figures for filling the silo are for a large crew that will keep a 16-inch cutter continuously running. Smaller crews often are used to advantage, however. Where a small crew is used, three men cut and load the corn without dropping it in bundles on the ground. Three teams are required. At any given time one will be loading, one unloading, and the third on the road. In unloading, the drivers hand directly to the feeder. No extra man need be employed where a gasoline engine is used. It will be of advantage to keep two men in the silo. Altogether the crew will consist of nine men and six horses, and the day's work per acre, when 2¼ acres are cut per day, will be 4 man-days and 2.66 horse-days. Four teams will be required for long hauls.

TABLE V.—*Crews and duty of machinery in planting, cultivating, and harvesting potatoes (average of 33 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
				10-hour day.		9-hour day.	
	Men.	Horses.		Men.	Horses.	Men.	Horses.
Cutting seed, 15 bushels	1	0	1.00	1.00	.....	1.11	.....
Planting, plowed in	3	2	2.50	1.20	0.80	1.33	0.88
Planting, picker type	1	2	4.00	.25	.50	.28	.56
Planting, 2-man type	2	2	3.50	.57	.57	.63	.63
Spike-tooth harrowing	1	2	13.00	.08	.16	.08	.16
Weeding	1	1	18.00	.05	.05	.06	.12
Cultivating	1	1	4.00	.25	.25	.28	.28
Cultivating, riding	1	2	6.10	.16	.32	.18	.36
Spraying (liquid), 4 rows	1	1	15.00	.06	.06	.07	.14
Digging with elevator	1	4	3.50	.31	1.26	.32	1.28
Digging with potato plow	1	2	3.00	.33	.66	.37	.74
Picking up and bagging [1]	1	0	.50	2.00	.....	2.22	.....
Hauling to cellar [2]	2	2	3.70	.54	.54	.60	.60
Sorting and bagging in cellar	1	0	.80	1.30	.....	1.40	.....
Hauling to market, 2 miles	1	2	1.20	.83	1.66	.93	1.86

[1] Average yield from 120 to 130 bushels.

[2] 9 loads of 50 bushels each.

Table V gives the crews and duty of machinery as the average on 33 farms for planting, cultivating, and harvesting potatoes. The potato planter is used by most of these farmers, but small areas are often planted by hand. These are of two types, the so-called picker machine, and the machine where a second man sits behind and regulates the dropping.

On small areas Paris green, mixed with plaster, is ordinarily used for beetles, but where 4 acres or more are planted, a liquid sprayer applies Paris green or arsenate of lead. A few farmers are spraying for blight.

Digging is done with a potato plow or other digging implement. One man can pick up in barrels or bags behind an elevator digger, on a field free from weeds yielding about 200 bushels per acre, about 100 bushels a day. Under Chester County conditions, however, and particularly after a potato-plow type of digger, 60 to 75 bushels is an average day's work. A few farmers sell immediately after digging, but the greater number store their potatoes and wait for a special market.

TABLE VI.—*Crews and duty of machinery in seeding and harvesting oats (average of 19 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
	Men.	Horses.		10-hour day.		9-hour day.	
				Man.	Horse.	Man.	Horse.
Seeding	1	2	9.50	0.11	0.22	0.12	0.24
Cutting, binder 6-foot cut	1	2	9.00	.11	.22	.....	.....
Do	1	3	10.80	.09	.27	.....	.....
Shocking	1	0	6.00	.17	.....	.....	.....
Hauling to barn [1]	2	2	6.00	.34	.34	.....	.....
Do	3	2	6.50	.46	.30	.....	.....

[1] All the farmers visited hire thrashing done at from 2 cents to 3 cents per bushel, furnishing fuel and board for the hands. Three to five men in addition are often furnished.

Table VI gives the crews and duty of machinery as the average on 19 farms for seeding and harvesting oats.[1]

TABLE VII.—*Crews and duty of machinery in seeding and harvesting wheat (average of 33 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
	Man.	Horse.		10-hour day.		9-hour day.	
				Man.	Horse.	Man.	Horse.
Seeding 6 to 8 foot drill [1]	1	2	9.50	0.11	0.22	0.12	0.24
Cutting, binder 6-foot cut	1	3	10.00	.10	.30	.....	.....
Shocking	1	0	5.40	.18	.....	.....	.....
Hauling to barn [2]	2	2	5.30	.36	.36	.....	.....
Hauling to barn	3	2	5.75	.51	.34	.....	.....

[1] Timothy can be seeded at the same time that the wheat is drilled, at no extra labor expense.
[2] All these farmers hire thrashing done at 4 to 5 cents per bushel, furnishing fuel and board for the hands. Three to five men in addition are often furnished.

Table VII gives the crews and duty of machinery as the average on 33 farms for seeding and harvesting wheat. In most cases the wheat is hauled to the barn and thrashed whenever it is convenient

[1] Some of the farmers in this region who were visited expressed their opinion that oats were unprofitable and a number of farmers are substituting soy beans for this crop. However, as but few farmers are growing soy beans, the data obtained were insufficient to present as an average for this crop. The figures given for preparation of land will apply for soy beans. When the crop is planted in rows the acreage planted per day will be greater than for potatoes and less than for corn. The figures given for wheat will apply to soy beans when this crop is drilled broadcast. In harvesting for hay, labor requirements about equal those given for alfalfa.

to obtain thrashers. A few are thrashing from the shock, and this is possible except in very unfavorable seasons.

TABLE VIII.—*Crews and duty of machinery in seeding and harvesting timothy and clover (average of 38 farms).*

Operation.	Crew.		Acres covered in 10-hour day.	Days per acre.			
	Man.	Horse.		10-hour day.		9-hour day.	
				Man.	Horse.	Man.	Horse.
Seeding with wheat drill	1	2	10.60	0.09	0.18	0.10	0.20
Clover seeding (wheelbarrow)	1	0	19.00	.05	.....	.06	.....
Mowing, 5-foot cut	1	2	9.50	.10	.20	.....	.....
Tedding, 6 to 8 feet wide	1	2	14.50	.07	.14	.....	.....
Raking, dump rake 8 to 10 feet wide	1	2	17.00	.06	.12	.....	.....
Raking, side-delivery rake	1	2	16.00	.06	.12	.....	.....
Piling in field	1	0	5.40	.18	.....	.....	.....
Loading, hauling, and storing:[1]							
8 loads, 1½ tons yield	3	2	5.50	.54	.36	.....	.....
12 loads, 1½ tons yield	4	4	8.50	.47	.47	.....	.....
13 loads, 1½ tons yield	5	4	9.00	.55	.44	.....	.....

[1] Loaded by hand, unloaded with fork. The results will be somewhat increased by the use of a hay loader.

Table VIII gives the crews and duty of machinery as the average on 38 farms for seeding and harvesting timothy and clover. The figures given for broadcasting with a wheelbarrow seeder are for using the seeder one way. Where one-half of the seed is drilled in one direction and one-half broadcasted in a cross direction, simply add the work units for seeding with drill and seeding with a wheelbarrow seeder.

Very few mowing machines wider than a 5-foot cut are used for the ordinary hay crop. The tedder is usually used for clover or for heavy timothy and mixed grasses. Both the dump and side-delivery rakes are used, but the latter is generally preferred. This implement is especially necessary if the hay is loaded with a loader from the windrow. The side-delivery rake will, furthermore, quite largely take the place of the tedder. The figures given for loading, hauling, and storing are based on pitching in the fields by hand and unloading in the barn with a horse fork or sling. Insufficient data were obtained on the use of a hay loader, but there is little doubt that in favorable weather the hay loader would be of decided advantage, particularly with timothy or mixed grasses.

Table IX gives the crews and duty of machinery as the average on 18 farms in seeding and harvesting alfalfa. Alfalfa is a comparatively new crop in Chester County, but a few successful growers were interviewed, from whom data were obtained. Inoculation has been done by applying soil from an old alfalfa field at the rate of 300 or more pounds per acre. Recently commercial cultures have been introduced. While the cost of these cultures usually exceeds the cost of applying soil, the convenience of handling is an important

factor. Cultures can be applied at no extra labor expense other than is required in the application to the seed.

TABLE IX.—*Crews and duty of machinery in seeding and harvesting alfalfa (average of 18 farms).*

Operation.	Crew.		Acres covered, 10-hour day.	Days per acre.			
				10-hour day.		9-hour day.	
	Men.	Horses.		Man.	Horse.	Man.	Horse.
Inoculating with soil	1	2	12.00	0.08	0.16	0.09	0.18
Drilling seed alone	1	2	14.30	.07	.14	.08	.16
Seeding (wheelbarrow machine)[1]	1	0	9.50	.10	.....	.11	.....
Mowing, 5-foot cut machine[2]	1	2	10.00	.10	.20	.11	.22
Mowing, 8-foot cut machine	1	2	15.00	.07	.14	.07	.14
Tedding	1	2	14.50	.07	.14	.07	.14
Raking, dump rake	1	2	17.00	.06	.12	.06	.12
Raking, side delivery	1	2	10.00	.06	.12	.07	.14
Cocking	1	0	6.00	.17	.....	.18	.....
Capping	1	1	20.00	.05	.05	.05	.05
Loading, hauling, and storing:[3]							
10 loads, 1½–2 tons yield	3	2	5.50	.54	.36	.58	.39
15 loads, 1½–2 tons yield	4	4	8.50	.48	.48	.50	.50
16 loads, 1½–2 tons yield	5	4	9.00	.55	.44	.60	.48

[1] One-half of the seed sown lengthwise, the remainder town crosswise.
[2] This record is for the first cutting. Three cuttings are usually made, but the second and third cuttings are lighter, and will require less labor.
[3] Loaded by hand and unloaded with fork. The results will be somewhat reduced by using a hay loader.

When hay caps are used, a cap 50 to 54 inches square, of lightweight canvas, is used. These may be weighted at their corners with stones or cement weights, or the cap may be fastened on the hay with wire pins. It is more convenient usually to distribute caps from a spring wagon or one-horse cart.

SUMMARY OF LABOR REQUIREMENTS OF CROPS.

In making use of the following figures on man and horse labor for the several operations in crop production, it is well to bear in mind that the data from which this tabulation was taken were collected from 165 farmers above the average of the county in progressiveness, receiving considerably more than the average net income. These men followed successful methods of soil and crop management, and in most cases laid emphasis on the careful preparation of the soil and careful cultivation. In some cases the number of hours per acre is greater than in some other regions.[1] They are, however, a good guide in estimating labor in this region or other regions having similar conditions. These summary figures are based on the practice of the majority of the farmers, as averaged in the preceding tables. Hence, for any individual case where a system of farm practice is followed differing from that outlined, the labor requirements can be revised and worked out from Tables III to IX.

[1] See "Farm Management," by Prof. G. F. Warren, of the College of Agriculture, Ithaca, N. Y.

FIELD OPERATIONS AND LABOR REQUIREMENTS (165 FARMS).

	Hours of labor per acre.	
	Man labor.	Horse labor.
Corn (for grain):		
Manuring	11.9	11.9
Plowing	5.5	11.0
Rolling, 2 times	1.4	2.8
Disking, 2 times	2.2	8.6
Spike-tooth harrowing, 2 times	1.6	3.0
Drilling fertilizer	1.2	2.4
Seeding	1.1	2.1
Cultivating	5.2	10.4
Cutting, 70-bushel yield	10.0	....
Husking, 70-bushel yield	19.0	....
Hauling grain	6.2	6.2
Hauling stalks	4.0	4.0
	69.3	62.4
Corn (for silage):		
Preparation, seeding, and cultivation	30.1	52.2
Harvesting and filling silo	35.0	20.0
	65.1	72.2
Potatoes:		
Manuring	11.9	11.9
Plowing	5.5	11.0
Rolling, 2 times	1.4	2.8
Disking, 2 times	2.2	8.8
Spike-tooth harrowing, 3 times	2.4	4.8
Cutting seed	10.0	....
Planting	4.1	5.3
Cultivating, 5 times	8.0	16.0
Spraying for bugs, 2 times	1.2	1.2
Digging	3.2	9.6
Picking up and bagging	20.0	....
Hauling and storing	5.4	5.4
Marketing	21.3	16.6
	96.6	93.4
Oats:		
Plowing	5.5	11.0
Rolling, 2 times	1.4	2.8
Spring-tooth harrowing, 2 times	2.0	4.0
Seeding	1.1	2.2
Cutting	.9	2.7
Shocking	1.7	....
Hauling to barn	3.4	3.4
Thrashing—hired done by contract	....	....
	16.0	26.1

Field operations and labor requirements (165 farms)—Continued.

	Hours of labor per acre. Man labor.	Horse labor.
Wheat:		
Plowing	5.5	11.0
Rolling, 2 times	1.4	2.8
Disking, 2 times	2.2	8.8
Spike-tooth harrowing, 2 times	2.0	4.0
Applying lime	1.8	3.6
Seeding	1.1	2.2
Cutting	1.0	3.0
Shocking	1.8	....
Hauling to barn	3.6	3.6
Thrashing—hired done by contract	....	....
	20.4	39.0
Clover and timothy:		
Seeding (seeded in August)—		
Plowing	5.5	11.0
Rolling, 2 times	1.4	2.8
Disking	1.1	4.3
Spring-tooth harrowing	1.0	2.0
Spike-tooth harrowing	.8	1.6
Seeding, wheelbarrow seeder	.5	....
	10.3	21.7
Seeded in wheat (timothy in fall)—		
Clover seeding in spring	.5	....
Harvesting—		
Mowing	1.0	2.0
Tedding	.7	1.4
Raking, 2 times	1.2	2.4
Piling	1.8	....
Loading, hauling, and storing	5.4	3.6
	10.1	9.4
Alfalfa:		
Seeding (after oats, wheat, or early potatoes)—		
Manuring	11.9	11.9
Plowing	5.5	11.0
Rolling, 4 times	2.8	5.6
Disking, 3 times	3.3	12.9
Spike-tooth harrowing, 2 times	1.6	3.2
Applying lime	1.8	3.2
Drilling fertilizer	1.2	2.4
Applying inoculated soil	.8	1.6
Drilling one-half the seed	.7	1.4
Cross seeding one-half the seed (wheelbarrow)	.5	0
	30.1	53.2

Field operations and labor requirements (165 farms)—Continued.

	Hours of labor per acre.	
	Man labor.	Horse labor.
First cutting—		
Mowing, 5-foot cut machine	1.0	2.0
Tedding	.7	1.4
Raking, 2 times	1.2	2.4
Cocking and capping	2.2	.5
Making over cocks and collecting caps	1.6	.5
Loading, hauling, and storing	5.4	5.4
	12.1	12.2
Second or third cuttings—		
Mowing	1.0	2.0
Raking, 2 times	1.2	2.4
Cocking and capping	1.7	.4
Repiling and collecting caps	1.3	.4
Loading, hauling, and storing	3.0	3.0
	8.2	8.2
Harvesting (without using hay caps)—		
First cutting—		
Mowing, tedding, raking, and piling	5.7	8.4
Loading, hauling, and storing	5.4	5.4
	11.1	13.8

PART II. HOW TO USE THE FOREGOING DATA.

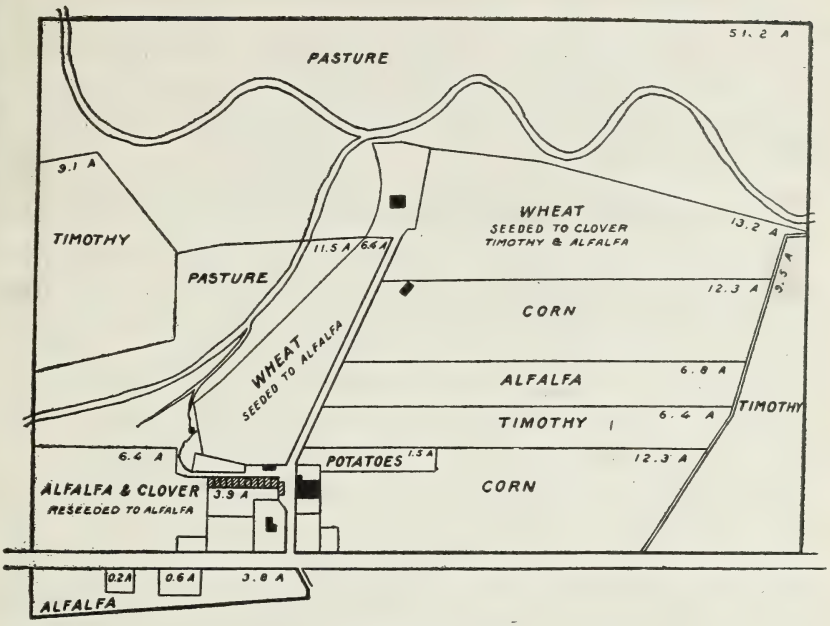
In order to show the use of the data given in the preceding tables, they are applied in the following pages to a particular farm located in the area of the survey.

DESCRIPTION OF FARM SELECTED.

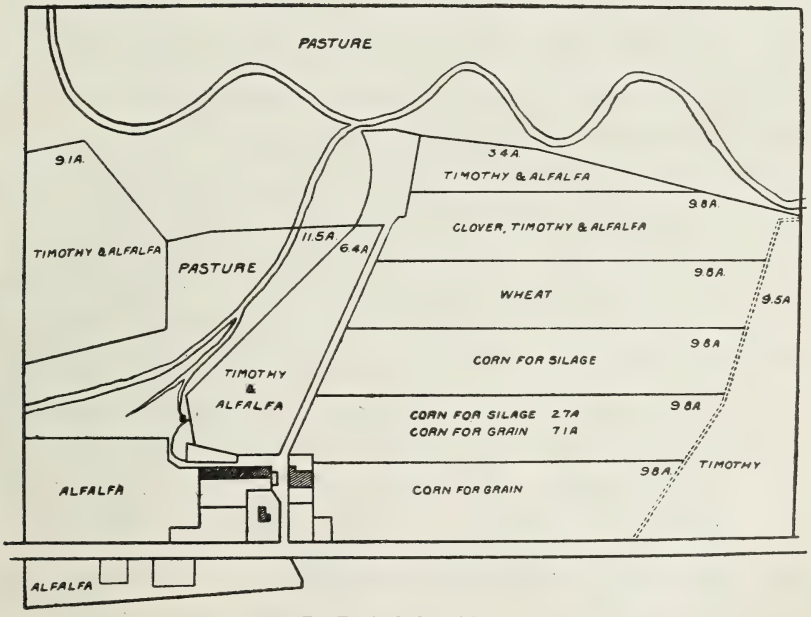
Map A (fig. 2) shows the field divisions, the acreage of each, the location of farm roads and buildings, and the crops grown on the farm selected. The farm contains about 155 acres, of which 63 acres, or about 40 per cent, are in permanent bluegrass pasture. This is badly cut by a stream, and therefore is not strictly tillable.

This farm in general is typical of the region, a large part of the income being derived from stock and stock products, mostly milk. The fact that alfalfa has been successfully grown was considered in the selection of this farm, as the growing of this crop is rapidly increasing in this county.

Though the fields are unequally divided, rougly speaking, the following rotation has been practiced: (1) Corn for grain; (2) corn for silage; (3) wheat; (4) clover and timothy; (5) timothy, one and sometimes two years. Recently alfalfa, 5 to 6 quarts per acre, has been added to the grass mixture. This requires that the grass be cut



A.—Original plan of farm.



B.—Revised plan of farm.

FIG. 2.—Old farm layout compared with the new.

before the timothy heads have blossomed in order to harvest the alfalfa before it matures. In favorable seasons a second cutting of alfalfa mostly is harvested. Small or irregular fields are put into alfalfa. The area devoted to corn and hay is somewhat above the proportion of these crops on the average dairy farm in this region.[1] This is due to the large number of live stock kept.

DETERMINING LABOR REQUIREMENTS OF OLD SYSTEM.

Table X gives the amount of man and horse labor required per acre for each month for the six crops grown on this farm. It is based upon the crew and work units as given in Tables III to IX, and also on the outline of the hours of labor required for the different operations. To find the total amount of labor required for any cropping system, multiply the figures given per acre in the above table by the number of acres of each crop to be grown. Assuming the acreage as given in map A (fig. 2), the total amount of man and horse labor on this farm will be distributed as shown in Table XI.

Figure 3 (A) is a graphic illustration of the time available and work to be done as given in Table XI. The area below the dotted line represents the available time each month for two men and a team of two horses and the shaded area the work that must be done. This chart shows the man-labor fairly well distributed in spring and early summer but not in late summer and fall. The increase of man-labor in June is due to the harvesting of the first crop of alfalfa and clover, and alfalfa and timothy mixture, which extends over into July. The increase of man-labor in July is due to the harvesting of wheat, the hauling of manure, and preliminary preparation of the ground for alfalfa and other new seedings, and in September to the extra labor required for cutting silage corn and corn harvested for grain.

The horse-labor also is distributed unevenly, requiring much more in July and August than during any other part of the season. This is largely due to the fact that 12.8 acres of alfalfa and 13.2 acres of clover and timothy were prepared and seeded at this time, in addition to the cutting of clover and timothy for hay, second cutting of alfalfa, and the harvesting of 19.6 acres of wheat. This amount of July and August work is a little unusual for this farm, as it happened that 6.4 acres of clover, alfalfa, and timothy required reseeding, and that about one-half more wheat was harvested than was seeded for the next year. When the fields are unequally divided, the amount of labor will always vary thus from year to year.

[1] See U. S. Dept. Bulletin No. 341, "Farm Management Practice in Chester County, Pa."

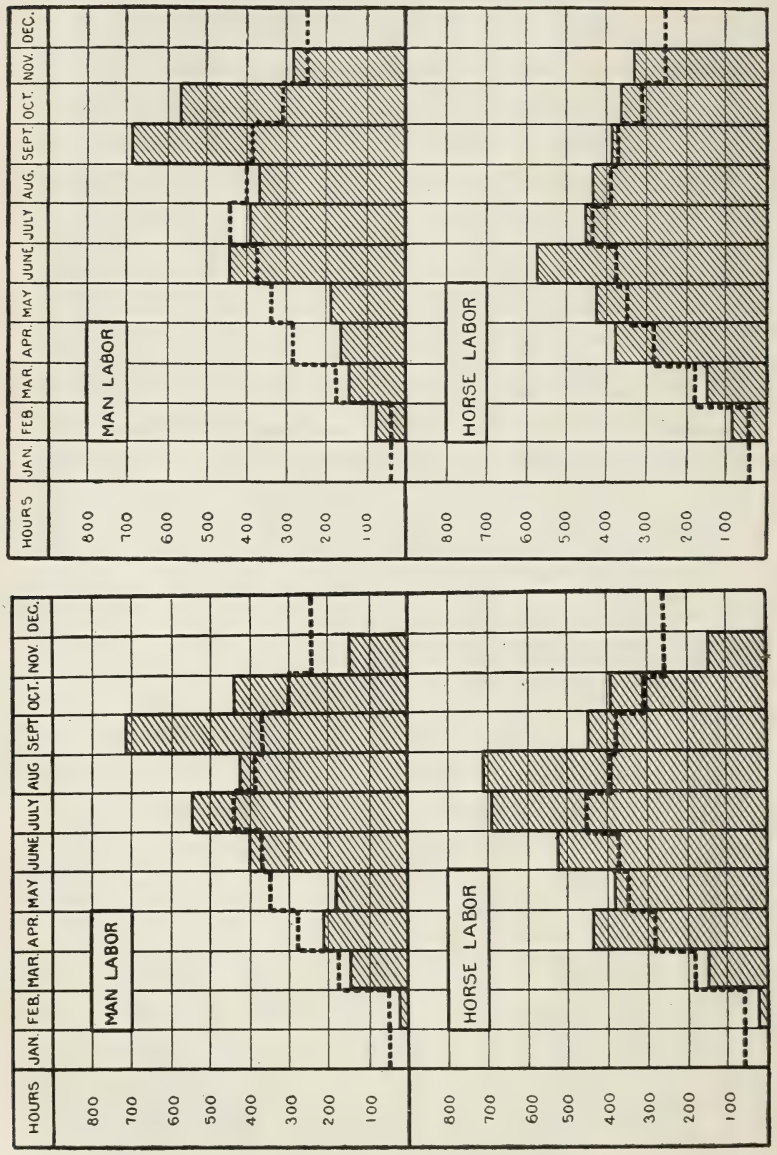
TABLE X.—*Field, labor requirements for different crops per acre as shown in Tables III to IX.*

Crop or operation.	February.		March.		April.		May.		June.		July.		August.		September.		October.		November.	
	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.
Corn for grain	.....	.....	.....	.....	8.4	21.0	5.4	10.2	4.4	9.1	.....	.....	.....	.....	14.0	.....	25.2	10.2	11.9	11.9
Corn for silage	.....	.....	11.9	11.9	5.5	11.0	8.3	20.2	4.4	9.1	.....	.....	.....	.....	35.0	20.0	.....	.....	.....	.....
Potatoes	11.9	11.9	1.1	2.2	22.9	27.3	5.6	11.2	4.8	8.8	0.4	0.4	7.1	3.7	21.5	11.3	21.3	16.6	.....	.....
Oats	.....	.....	.....	.....	10.0	20.0	.....	.....	.....	.....	2.6	2.7	3.4	3.4	.....	.....	.....	.....	.....	.....
Wheat, including clover and timothy seeding	.....	.....	.....	.....	0.5	.....	.....	.....	.....	.....	6.4	6.6	.....	.....	6.2	12.4	7.8	20.0	.....	.....
Clover and timothy seeding in August	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.2	7.6	7.1	14.1	.....	.....	.....	.....	.....	.....
Harvesting clover and timothy	.....	.....	.....	.....	.....	.....	.....	.....	5.0	4.7	5.1	4.7	.....	.....	.....	.....	.....	.....	.....	.....
Alfalfa seeding	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.0	17.7	20.1	35.5	.....	.....	.....	.....	.....	.....
Harvesting alfalfa, 3 cuttings	.....	.....	.....	.....	.....	.....	.....	.....	12.1	12.2	8.2	8.2	6.2	6.2	2.0	2.0	.....	.....	.....	.....
Top-dressing and harrowing alfalfa sod	.....	.....	.....	.....	.....	.....	.....	.....	2.7	5.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE XI.—*Field labor requirements for 87.7 crop acres.*

Crop or operation.	February.		March.		April.		May.		June.		July.		August.		September.		October.		November.	
	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.
Corn for grain, 12.3 acres	.....	.....	.....	.....	103	258	66	125	54	112	.....	.....	.....	.....	172	.....	310	125	146	146
Corn for silage, 12.3 acres	.....	.....	146	146	68	135	102	248	54	112	.....	.....	.....	.....	430	246	.....	.....	.....	.....
Potatoes, 1.5 acres	18	18	2	4	34	41	8	16	7	13	1	1	11	5	32	17	32	25	.....	.....
Clover, timothy, and alfalfa mixture—harvesting hay, 31.4 acres	.....	.....	.....	.....	.....	.....	.....	.....	157	147	160	147	.....	.....	.....	.....	.....	.....	.....	.....
Alfalfa, 10.6 acres—harvesting hay	.....	.....	.....	.....	.....	.....	.....	.....	128	129	87	87	66	66	21	21	.....	.....	.....	.....
Wheat harvesting, 19.6 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	125	129	.....	.....	.....	.....	.....	.....	.....	.....
Alfalfa seeding, 12.8 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	128	227	257	454	.....	.....	.....	.....	.....	.....
Clover and timothy seeding, 13.2 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42	100	94	186	.....	.....	.....	.....	.....	.....
Wheat seeding, 12.3 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	76	153	96	246	.....	.....
Total	18	18	148	150	205	434	176	389	400	513	543	691	428	711	731	437	438	396	146	146

When a type of general farming is followed which carries no animals except work stock, the horse-labor should run much more evenly than on a dairy farm. Data which have been obtained from these



B.—Revised cropping system.

A.—Original cropping system.

FIG. 3.—Available time for two men and one 2-horse team compared with work that must be done (dotted line, available time; shaded area, work to be done).

farmers show that on a dairy farm, as a rule, at least 30 to 40 per cent of the total labor required will be work other than field operations. While it may appear that the man and horse labor is not well employed on this farm in April, May, and June, considerable labor always is

required at this season for repairs and improvements of fences, buildings, or implements, and the hauling of fertilizer, feed, and milk, which is not shown in this chart.

REPLANNING CROPPING SYSTEM.

After having studied this cropping system from the standpoint of labor, the next point is to consider whether or not the cropping system can be changed, either by rearranging the fields to establish a definite rotation, by rearranging the acreages of crops, or by the introduction of new crops to balance the months of very high labor requirement, so as to increase the net income of the farm. The effect on the income of the farmer is the primary point of view to be taken in replanning a farm, taking into consideration, of course, the maintenance of soil and equipment and the availability of labor. If extra horse or man labor can be obtained whenever necessary, a farmer may be justified in practically ignoring labor requirements and selecting those enterprises which are best adapted to the farm conditions.

The layout of the farm in question was studied with a view to such rearrangement and a 7-year rotation was established as follows:

1. Corn for grain.
2. Corn (for grain, 7.1 acres; for silo, 2.7 acres.)
3. Corn for the silo.
4. Wheat.
5. Clover, timothy, and alfalfa hay (2 cuttings).
6. Timothy and alfalfa hay (2 cuttings).
7. Timothy and alfalfa hay (mostly alfalfa).

In contemplating a change in the cropping system the rotation must conform to the general layout of the farm. There are often conditions which prevent the readjustment of fields in the manner desired. Moreover, it is desirable to make changes that will require the least expense. The rotation outlined in the revised plan of this farm is not a rotation generally recommended for the average Chester County farm, but is suggested because it is best adapted to the existing field arrangement. Under ordinary farm practice, with clover one year, followed by timothy for one or two years, three years of corn in succession might have an influence to decrease crop yields. On this farm, however, the influence of an alfalfa sod supplemented by an application of manure to the corn crop will tend to increase, rather than decrease, crop yields.

The principal crop area was divided into five fields of 9.8 acres each, a triangular field of 3.4 acres at the farther end of this tillable tract, and one field of 6.4 acres formerly in wheat seeded to alfalfa on the other side of the farm lane, making together 9.8 acres which

can be planted to the same crop. The seventh field to enter into the rotation will be the 9.1-acre field, separated from the pasture area. In addition to the rotation area, 10.2 acres can be kept permanently in alfalfa and 9.5 acres in timothy, reseeding any portion when necessary by first planting corn for the silo, following with wheat. The 9.5 acres of permanent timothy is a field that is irregularly shaped for cultivation, rather low, and best suited to this crop.

The periods of harvesting corn for grain, for plowing sod, and for hauling manure, have been varied (within the limits of possibility, however) from the outline given in Table X, in order to facilitate labor. It was found that by increasing the acreage of field corn, and decreasing the acreage of alfalfa, the crops could be handled with about the same amount of labor, but that this labor would be much more evenly distributed throughout the season.

Table XII gives the total amount of man and horse labor required under the revised system. Because of the increased acreage of corn, a part of the labor for harvesting this crop was carried over into November, and the figures for this month also include the manuring and plowing of 9.8 acres of sod land to be planted to corn for grain the next season. The balance of the corn land to be planted for grain will be manured in February and the area for silage manured in March.

The graphic illustration of the labor required in the replanned cropping system (fig. 3, B) shows a much more even seasonal distribution of horse labor. The greatest variation comes in June, which is due to the fact that the grass mixture contains alfalfa, which requires early harvesting. Because of the labor requirements in enterprises other than field crops, it is possible that four farm horses should be kept on this farm. By arranging the work and concentrating all efforts on the field crops during the month of June, it is probable that this harvesting can be done without hiring extra horse labor. When it is necessary to reseed the permanent alfalfa or timothy, the horse-labor for August will be greater than represented on the chart, but in no case greater than for June.

The man-labor requirements for September and October are much greater than for any other month. This condidtion is hard to change. It may be possible, however, to lower the amount of man labor in September by the use of a corn harvester, and this can be done without radically changing the horse-labor distribution. It is comparatively easy, furthermore, to hire extra labor in husking corn. If the farm help is needed in thrashing wheat, this operation could more advantageously be done in the month of August.

TABLE XII.—*Field labor requirements (revised).*

Crop or operation.	February.		March.		April.		May.		June.		July.		August.		September.		October.		November.	
	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.	Man-hours.	Horse-hours.
Corn for grain, 16.9 acres	84	84	.....	.....	88	247	91	172	74	154	.....	.....	.....	.....	169	.....	493	172	171	225
Corn for silage, 12.5 acres	.....	.....	149	149	69	138	103	252	55	114	.....	.....	.....	.....	438	250	.....	.....	.....	.....
Wheat, 9.8 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	63	64	.....	.....	61	122	76	196	.....	.....
Timothy, clover, and alfalfa, first cutting, 38.3 acres	.....	.....	.....	.....	.....	.....	.....	.....	193	180	194	180	.....	.....	.....	.....	.....	.....	.....	.....
Clover and alfalfa, second cutting, 28.8 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	236	236	.....	.....	.....	.....	.....	.....
Alfalfa, three cuttings, 10.2 acres	.....	.....	.....	.....	.....	.....	.....	.....	123	124	84	84	63	63	20	20	.....	.....	.....	.....
Top-dressing timothy with manure, 9.5 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	113	113
Top-dressing alfalfa with fertilizer, 10.2 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28	56	.....	.....	.....	.....	.....	.....	.....	.....
Clover, timothy, and alfalfa seeding, 9.8 acres	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31	74	70	138	.....	.....	.....	.....	.....	.....
Total	84	84	149	149	157	385	194	424	445	572	400	458	369	437	688	392	569	368	284	338

COMPARATIVE LABOR REQUIREMENTS.

The calculated cost of man and horse labor required in field operations for the cropping systems illustrated in figure 2 from March to November, inclusive, is as shown in Table XIII.

TABLE XIII.—*Comparative labor requirements.*

ORIGINAL CROPPING SYSTEMS.

Crop or operation.	Acres.	Man labor.	Horse labor.	Total.
Corn for grain	12.3	$119.33	$84.42	$203.75
Corn for silage	12.3	112.10	97.69	209.79
Potatoes	1.5	20.29	15.41	35.70
Harvesting mixed hay[1]	31.4	44.40	32.46	76.86
Harvesting alfalfa hay	10.6	42.29	33.35	75.64
Harvesting wheat	19.6	17.56	14.23	31.79
Seeding wheat	12.3	24.11	43.84	67.95
Seeding alfalfa	12.8	53.94	74.91	128.85
Seeding clover, timothy, and alfalfa	13.2	19.04	31.51	50.55
Total		453.06	427.82	880.88

REVISED CROPPING SYSTEMS.

Corn for grain	16.9	$163.96	$115.99	$279.95
Corn for silage	12.5	113.93	99.27	213.20
Harvesting mixed hay[1]	38.3	87.22	65.56	152.78
Harvesting alfalfa hay	10.2	40.70	32.09	72.79
Harvesting wheat	9.8	8.78	7.11	15.89
Seeding wheat	9.8	19.21	34.93	54.14
Seeding clover, timothy, and alfalfa	9.8	14.13	23.39	37.52
Topdressing timothy with manure	9.5	15.82	12.43	28.25
Topdressing alfalfa with fertilizer	10.2	3.92	6.16	10.08
Total		467.67	396.93	864.60

[1] A second crop, mostly alfalfa, on 28.8 acres will be cut the second time.

In the preceding table it is obvious that the changes in the cropping system can be made without increasing the cost of labor. The rearrangement has increased the amount of man labor, but on the other hand decreased the amount of horse labor. The total cost of horse labor was decreased to the amount of $30.89, and the total labor, $16.28.

COMPARATIVE RETURNS.

A comparison of the gross incomes from crops in the two cropping systems will give further light on the relative desirability of the two systems. The values assumed, based on the average yield of crops obtained by successful farmers in the locality and on market prices at the farm, are shown in Table XIV.

Thus it will be seen that the revised system brings a gross income of more than $550 over that of the first system, while the total labor bill is at the same time reduced from $880.88 to $864.60.[1] The saving in this case is not so much in amount of labor as in its utilization.

[1] It is impossible in this bulletin to work out all the factors which enter into the total cost of the crop. There is so much variation in the previous management of the soil, in the soil conditions in respect to the amounts of fertilizer used, the rental charge for land, the equipment charge and overhead charges, that these costs should be worked out for each individual case.

TABLE XIV.—*Comparative returns.*

Crop.	Yield per acre.	Price per unit.	Gross income.	
			First system	Second system.
Corn for grain	70 bushels	$0.60	$516.60	$709.80
Corn for silage	12 tons	4.00	590.40	600.00
Corn stover	2 tons	4.00	98.40	135.20
Potatoes	125 bushels	.60	112.20	
Mixed hay, first cutting	2 tons	16.00	1,004.80	1,225.60
Mixed hay, second cutting	1 ton	18.00		518.40
Alfalfa, 3 cuttings	3.5 tons	18.00	667.80	642.60
Wheat	25 bushels	.95	465.50	232.75
Wheat straw	1 ton	5.00	98.00	49.00
Total			3,553.70	4,113.35

CONCLUSION.

It is plain to be seen from this comparison that the consideration of the labor requirements of a farm in working out any plan of farm organization and carrying the plan into operation is not the least important factor in farm management. Too many times this matter has received very little attention, particularly with farmers with but little farm experience. A study of these questions gives a basis of increasing labor efficiency. The real object of this bulletin is not to show what the farmers in Chester County are doing, but to illustrate principles which may be applied anywhere in devising a cropping system for efficient utilization of labor.

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